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CONTROL EQUIPMENT
FOR
MOBILE COLOR LIGHTING

GENERAL ELECTRIC

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INTERNATIONAL

CONTROL EQUIPMENT
FOR
MOBILE COLOR
LIGHTING

GENERAL ELECTRIC COMPANY
Schenectady, N. Y.

GEA-1444

The Cover Illustration

THE artistic illumination of A. E. Staley Company's administration building, at Decatur, Ill., gives nightly evidence that mobile color floodlighting—a scientific innovation in exterior illumination—continuously revealing new and beautiful aspects of the structure, is in entire harmony with established canons of design.

Illuminated at night by 195 General Electric floodlighting projectors, the building rises as a brilliant white tower to the eleventh floor, where the colored lighting effects are first brought into play. The structural design of this upper portion is emphasized by the softly changing tints, that combine and recombine in seemingly endless variety. Color lenses provide the basic hues—red, amber, and blue, with white—which, dimming and brightening, mix to form an infinite succession of brilliant colors and subtle pastel shades. The whole system of illumination, planned as an artistic unit, accentuates the setback design of the building and attracts the attention of thousands.

General Electric lighting specialists, who coöperated in designing the floodlighting system, utilized the economical Thyratron-reactor system to control the color changes and intensities in the individual sections of the installation. General Electric offers you its counsel and experience in considering or designing the lighting of any building—erected or planned—with this system. A lighting specialist may be reached by addressing the nearest G-E office.

GENERAL ELECTRIC

Control Equipment
for
Mobile Color Lighting

GENERAL ELECTRIC engineers have perfected a new and striking development in the art of decorative lighting. At the present time, this method has been applied principally to the projection of richly hued, ever changing color designs upon architectural exteriors and interior areas of wall and ceiling. In both cases, operation and intensities are centrally controlled through a G-E Thyratron-reactor control system.

This spectacular painting with light—with its possibilities of almost infinite change in design and tint—is accomplished by the use of floodlighting projectors with colored lenses for exterior illumination, and, for interior applications, by color caps over standard incandescent lamps or by standard theater-lighting equipment. The dimming and mixing of the primary colors, red, blue, and green, permit an endless variation of tints and shades covering the full range of the spectrum. The dimming of one series of lights as another comes on produces effects so surprising and yet so artistic that G-E mobile color lighting is revolutionizing the illumination and decoration of hotels, ball-rooms, theaters, and public buildings, both interior and exterior, and electric fountains and show windows.

Until the perfection of G-E Thyratron-reactor control, mobile color lighting was possible only by the use of mechanically controlled resistance or reactance dimming equipment. This involved large numbers of heavy mechanical and electric parts, which were usually operated by hand and were very inefficient. In contrast to this, G-E Thyratron-reactor control, which is highly efficient and reliable, is entirely electric and provides flexibility that has not been equalled with any other type of equipment.

This system involves principally the use of three devices—a small induction voltage regulator, the grid-controlled rectifying tube marketed under the trade name "Thyratron," and a new type of saturable-core reactor. (See Fig. 5 on page 8.) The control apparatus can be placed in any desired location, since only small currents and low voltages are required for interconnection.

FLOODLIGHTING OF EXTERIORS

The comparatively recent use of color in the floodlighting of office buildings, banks, memorials, etc., has greatly increased the effectiveness of the art. With G-E mobile color lighting, the striking beauty of several different color combinations can be obtained automatically and economically, and they can be repeated in an ever changing procession. One of the most conspicuous examples of G-E mobile color lighting is now in operation on the administration building of the A. E. Staley Company, Decatur, Ill. (See cover illustration and also description on opposite page.)

In the design of a modern structure, the architect usually provides several setbacks with moderately high cornices, flying buttresses, etc. These together with paneled façades of evenly matched stone contribute to the effectiveness of the lighting.

The floodlighting projectors can be mounted in groups and concealed from view by the cornices. Lenses of blue, red, amber, and white are generally used to accentuate the architectural motif. The wattage ratio of the blue, red, amber, and white projectors can be determined by studying the visual effect of the different colors and the atmospheric absorption. Correct grouping of the projectors assures an effect of uniform intensity of the various colors used to light each section of the building.

The individual control of the color intensities of a mobile color system follows a definite color cycle and produces many changes in color combination. The basic cycle provides a complete color change every few seconds, although the same combination of effects in all sections occurs only once in several minutes.

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Fig. 1
"Edison" Fountain, Grand Circus Park, Detroit

ELECTRIC FOUNTAINS

To-day, the electric fountain is a comparatively inexpensive municipal improvement, and General Electric engineers have developed the most brilliantly impressive applications of the art. The construction of these fountains embodies submersed lighting units and automatic control of both the color and lighting effects. By night, the illuminated electric fountain is a fascinating spectacle. The water, brilliantly lighted in ever changing colors of red, amber, green, and blue, rises and falls, weaves in and out—all automatically.

Thyratron-reactor control is ideal for electric fountains because it produces finer gradations of tone than can be obtained with resistance dimmers. One color change can be made to blend into another, and any desired color combination can easily be obtained. Also, the inherent advantages of very high efficiency and simplicity, through the elimination of mechanical parts, contribute much to make Thyratron-reactor control the most desirable for this application.

There is a G-E Novalux electric fountain for every kind of location—park, city square, basin, or lake. Each type is shipped as a complete mechanical and electrical unit, ready to be set up and connected. Ask your nearest G-E office for complete information.

Fig. 2
Cove Lighting at the Pavillon Caprice (the Netherland-Plaza Hotel, Cincinnati), Controlled by G-E Thyratron-reactor Equipment. (Architect, Walter W. Ahlschlager)

INTERIOR LIGHTING

The use of mobile color lighting as the main decorative motif of ceilings, walls, and coves, in private residences as well as in large assembly halls, restaurants, roof gardens, cabarets, etc., has met with rapidly increasing favor because it provides almost unlimited possibilities of decoration. It answers the need for a simple and yet flexible means of changing the decorative scheme, both as to color and lighting intensity, and it enables the host to decorate in accordance with the spirit of the occasion.

The correct use of mobile color lighting is unsurpassed for the creation of an atmosphere in keeping with various types of entertainment; it complements any display and helps to stimulate the interest of the audience. Theatrical producers depend, in large measure, upon the correct lighting of each scene in order to influence the emotions of the audience. Likewise, any revue, fashion show, dance, or symphony is enhanced with correct lighting effects.

The owners of large residences have found in mobile color lighting a delightfully novel method of furnishing entertainment for their guests. Its use emphasizes the architectural beauty of the surroundings, lends an enchanting atmosphere to musical programs, and blends harmoniously with variously colored costumes on festive occasions.

The almost imperceptible and yet definite changes of light intensity and color that are made possible, automatically, with G-E Thyratron-reactor control equipment create illusions that merit the interest of every interior decorator.

Fig. 3
Thyratron-reactor Control Is Ideal for Show-window Lighting

SHOW-WINDOW LIGHTING

Mobile color lighting has proved to be one of the most effective means of attracting attention to a show-window display. Its use in any modernistic scheme of decoration makes possible an almost infinite number of color-lighting combinations and the advantageous use of various light intensities, according to predetermined settings of the automatic control equipment.

An attractive show window, like an attractive stage setting, profits greatly from a pleasing harmonious background which tends to set off the "leaders." Supplementary lighting in the form of spotlights may also be used to accentuate the objects as desired. And if the spotlights produce a white light (on a steady circuit), the mobile color background serves a definite purpose by attracting attention without detracting from the appearance of the objects on display. In this arrangement, the spotlights act as pointers that emphasize the objects within the area of their respective beams.

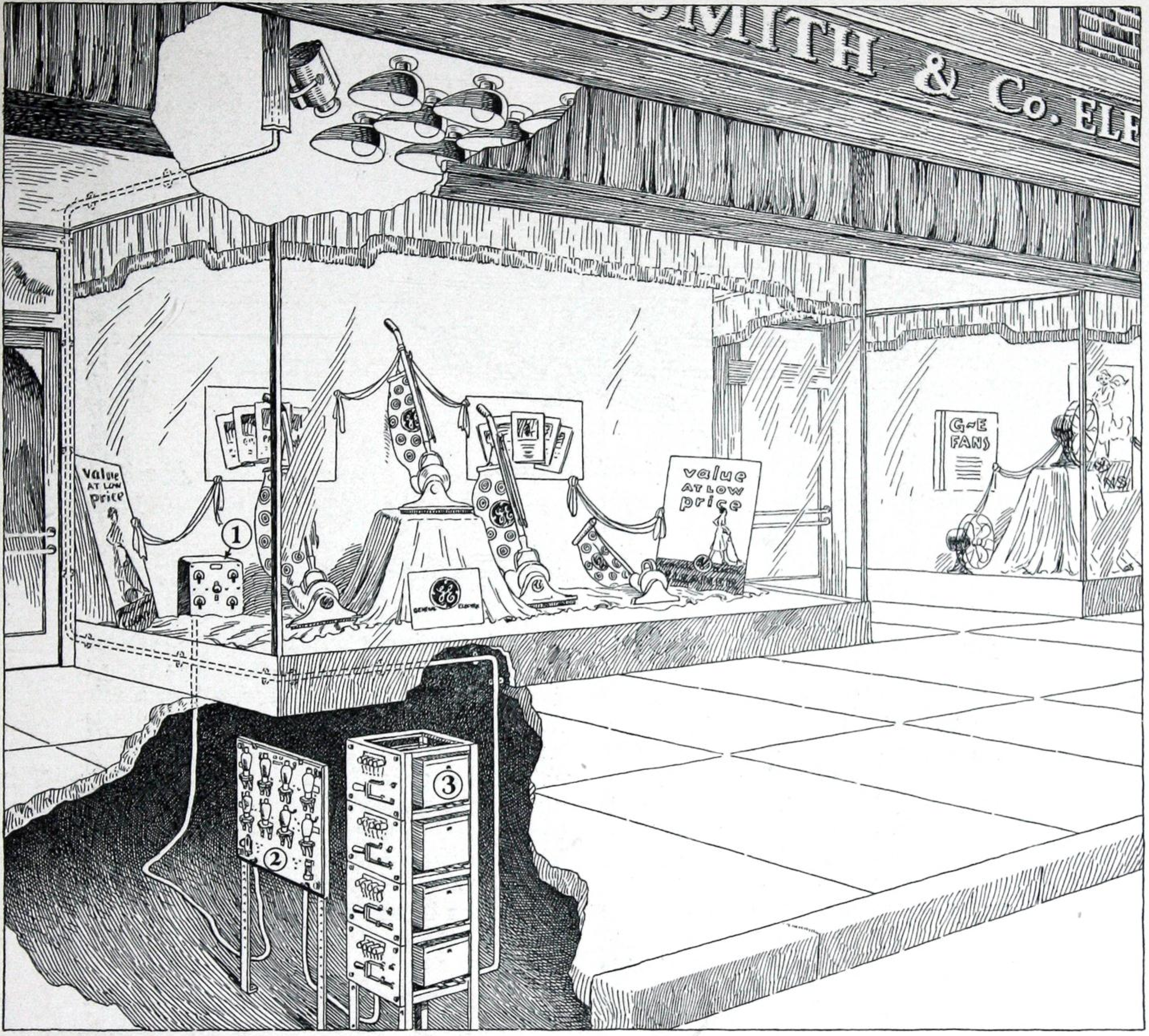

Fig. 4

Thyratron-reactor Control Equipment for Show-window Lighting. This includes a manual or automatic voltage regulator timer panel (No. 1), a Thyratron tube panel (No. 2), and a reactor rack and distribution panel (No. 3). The voltage regulator (No. 1) can be located where it is most convenient for adjusting the color effects

Furthermore, by using a different time-cycle setting of the control for each color in the background, it is possible to obtain a beautiful combination of colors that fades gradually (and automatically) to a dim monotone, leaving the white spotlight effects undiminished and apparently more brilliant.

The possibilities of even this simple and automatically controlled decoration are manifold. For instance, if the spotlights are connected to different mobile-control circuits, it is possible, by dimming and brightening, to direct attention first to one object and then to another.

The background surface should have a neutral tint so that it will present a pleasing appearance under all colors. Or, if desired, it may consist of a material that will give an iridescent effect.

In all cases, it should be remembered that if color lighting is used, lamps of comparatively high wattage are required in order to compensate for the loss of light that always occurs when white light is passed through a colored filter.

The control unit, Type CR7502-A1, can also be used to control decorative lighting within the store so that other lighting effects will vary simultaneously with those in the show window.

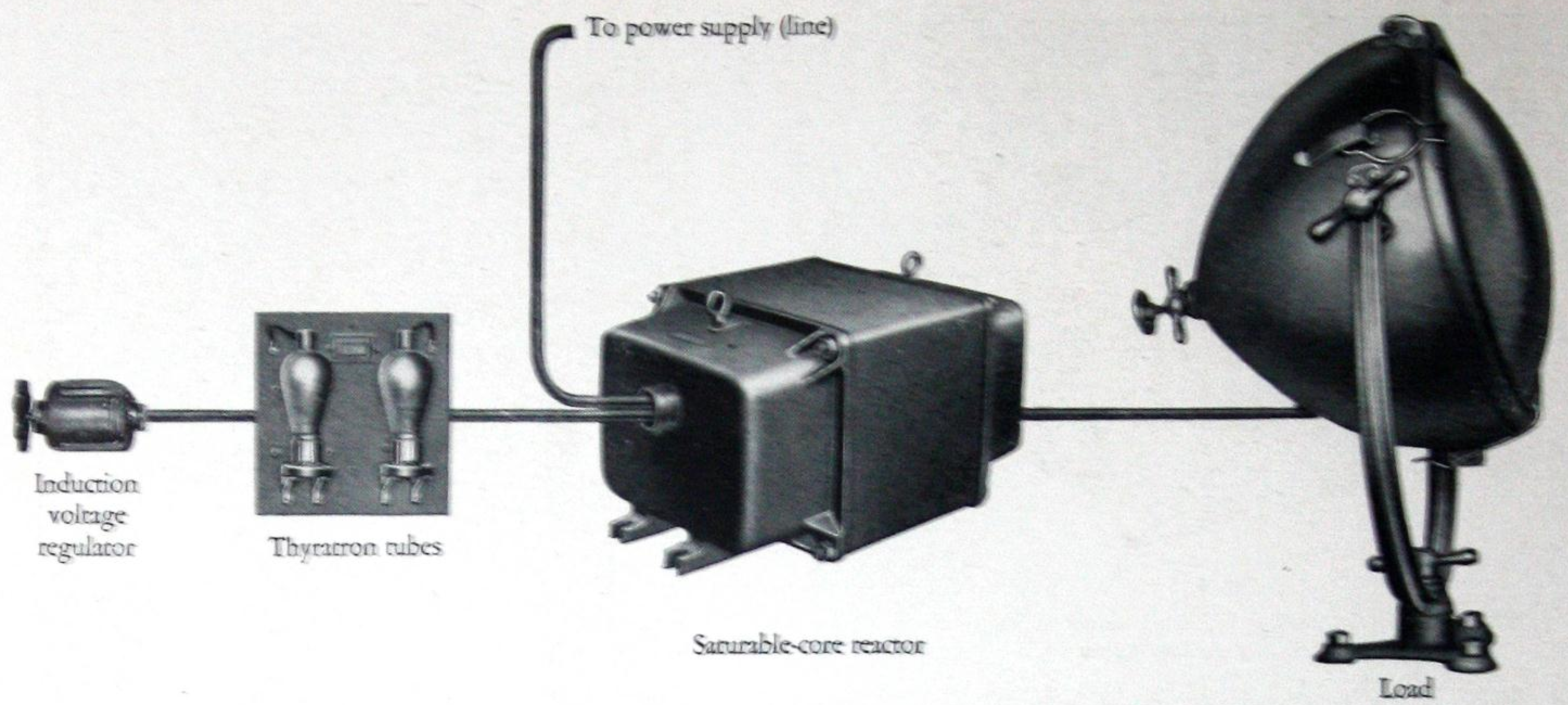

Fig. 5
The Principal Elements of a Single Thyratron-reactor Circuit

THYRATRON-REACTOR CONTROL

General Electric mobile color lighting control is made possible by the Thyratron tube, a development of the General Electric Research Laboratory. The Thyratron is a three-element rectifying tube the output of which is always under control. The amount or flow of the rectified (direct) current is regulated by the application of the proper voltage on the grid circuit of the tube. Therefore, the Thyratron tube may be considered as a combination rectifier and regulator which is independent of metal contacts, brushes, etc., and produces smooth, gradual changes in the flow of current—a desirable feature that cannot be obtained with the resistance dimmer.

The Thyratron tube requires an alternating-current power supply. A small induction voltage regulator is used to control the grid voltage which in turn controls the direct-current output of the tube.

Heavy currents of the magnitude required by a large number of incandescent lamps cannot be carried directly by the Thyratron tube. Therefore, a saturable-core reactor is interposed between the tubes and the lighting-load circuit. A saturable-core reactor consists principally of a laminated iron core with two windings, one for alternating current and one for direct current. These windings are so arranged that all transformer action is prevented. The a-c. winding is in series with the lighting circuit and carries the load current, the amount of which is determined by the excitation supplied to the d-c. winding from the tube circuit. The voltage drop across the a-c. winding of the reactor and, hence, the intensity of light output is controlled directly by the amount of direct current flowing through the d-c. winding.

With the induction voltage regulator set so that there is practically no current passing through the d-c. winding of the reactor, all lamps in the lighting circuit will be dimmed completely out. By turning the induction voltage regulator 180 mechanical degrees from this position, the maximum amount of current will be rectified by the tube and, hence, will flow in the d-c. circuit of the reactor. Then, the inductance or choking effect of the reactor in the lighting circuit is neutralized and the lamps burn at their maximum brilliancy.

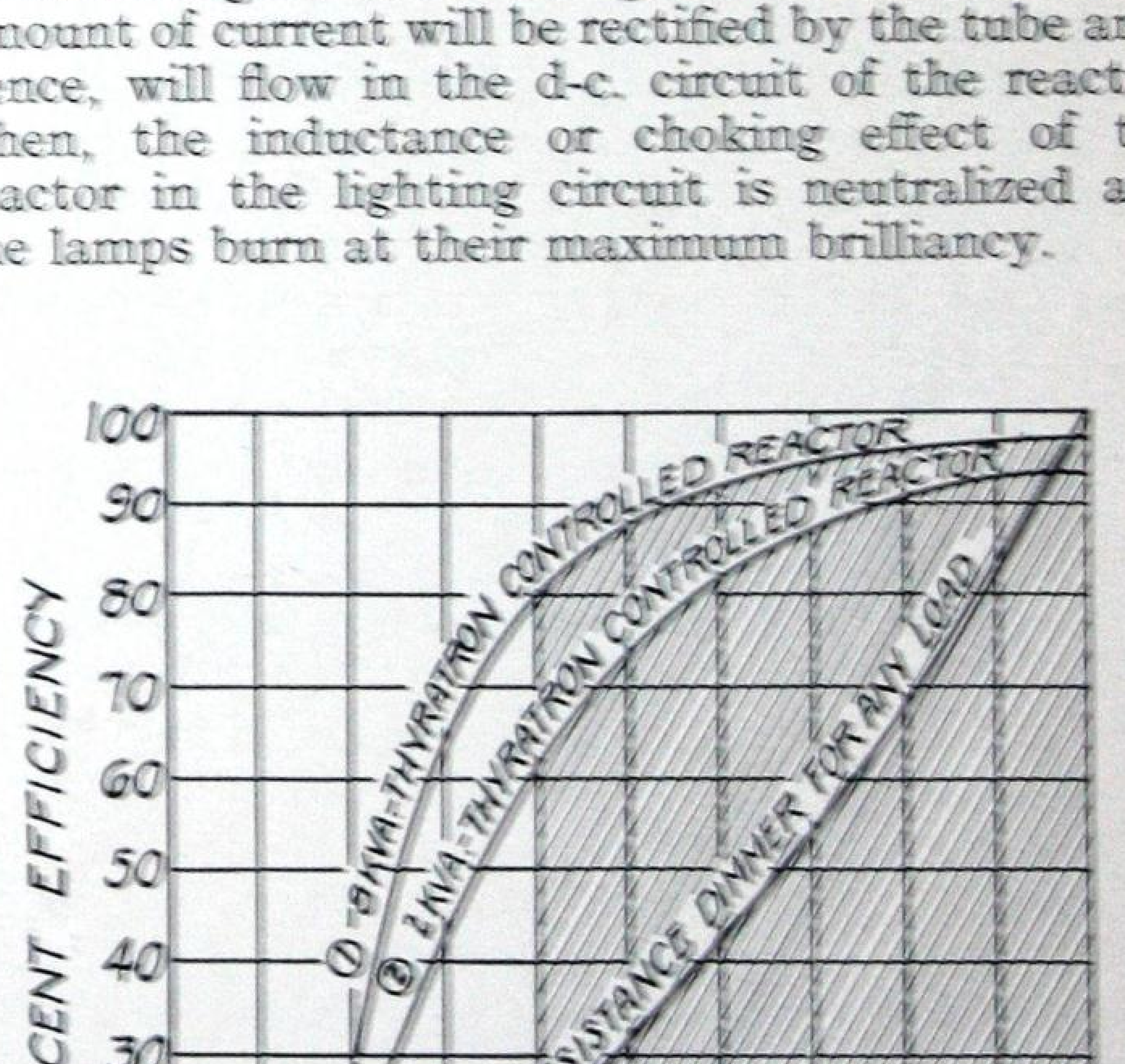

Fig. 6
The Shaded Portion under Each Curve Represents Actual Operating Range When Lamps Are Dimmed to 20 Per Cent Normal Voltage

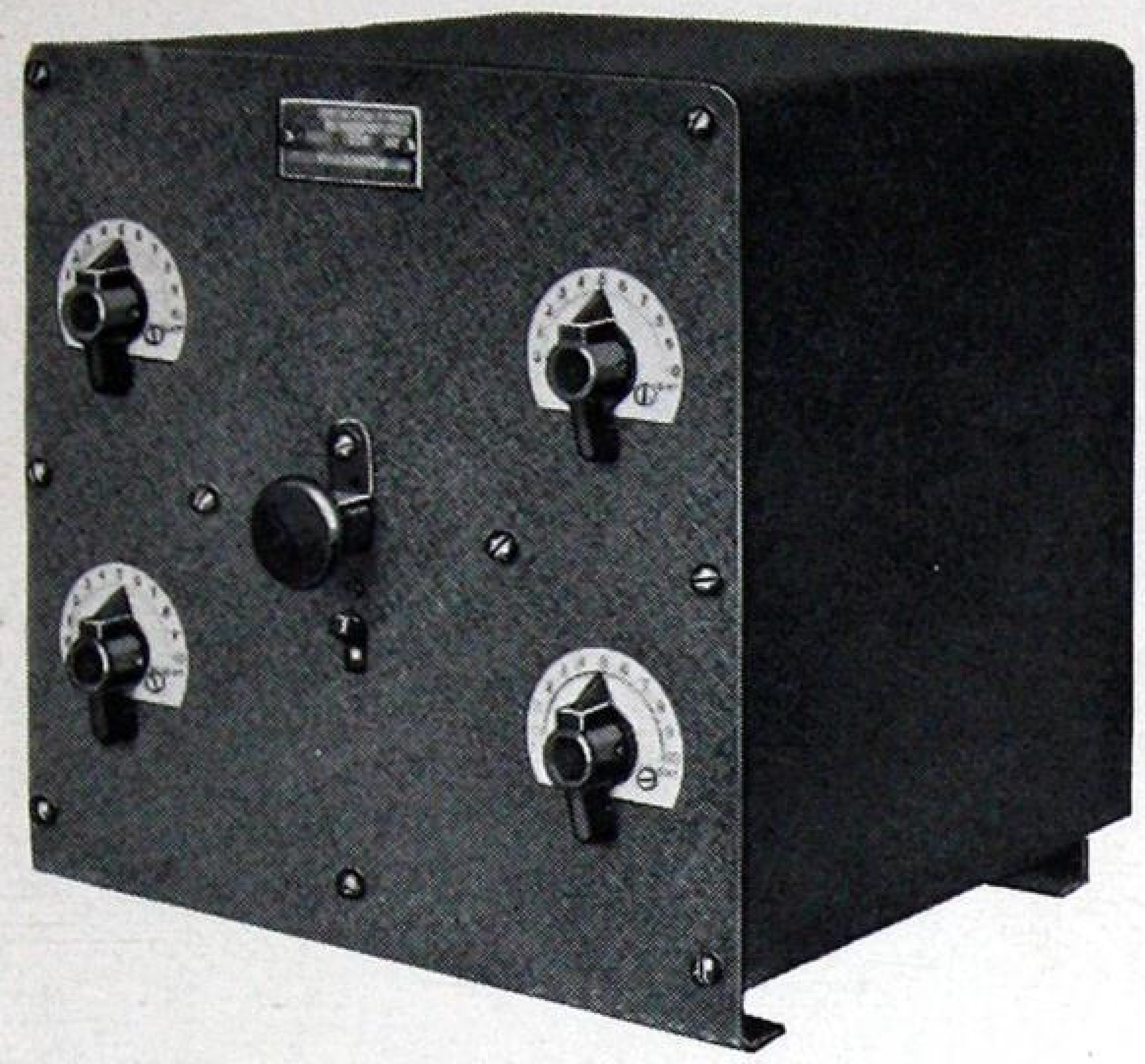

Fig. 7
Front View of Induction Voltage Regulator Timer for Thyratron-reactor Control

The rate of dimming and brightening is directly proportional to the speed at which the induction voltage regulator is turned. A wide range of adjustment is provided to permit increasing or decreasing the rate of dimming in relation to the rate of brightening, or vice versa, as desired. This adjustment is accomplished by small potentiometers connected in the output circuit of the induction voltage regulator in such a way as to produce the desired shape of the dimming cycle. This permits adjustments of the dimming curve to meet specific requirements.

The induction voltage regulator is equipped with a clutch so that it may be turned either by hand or by a small electric motor with changeable gearing to produce the desired color cycles. The changeable gearing is readily accessible from the back of the timer unit, and, by inserting various combinations of gears, each circuit can be adjusted for a complete cycle in 6, 15, 21½, 30, 42, 60, or 150 seconds. When all adjustments are made, the voltage regulator can be engaged with the motor for automatic operation.

The voltage regulator can be mounted at a point remote from the Thyratron tube and reactor equipment as it requires but a single cable with nine small conductors to connect it with the Thyratron tubes. The tubes and reactors are usually installed in the most convenient location at the center of distribution, which effects a saving in feeder copper.

To simplify the description of Thyratron control, we have discussed a single circuit with its voltage regulator, a pair of Thyratron tubes, and saturable-core reactor. Although a single circuit will control up to a maximum of 50 kw. on one pair* of tubes, it provides for only one mobile color cycle. Additional colors or additional combinations of colors require additional circuits. Standard equipment is available for the control of four circuits and multiples thereof, with provision for manual or automatic operation or combination of both.

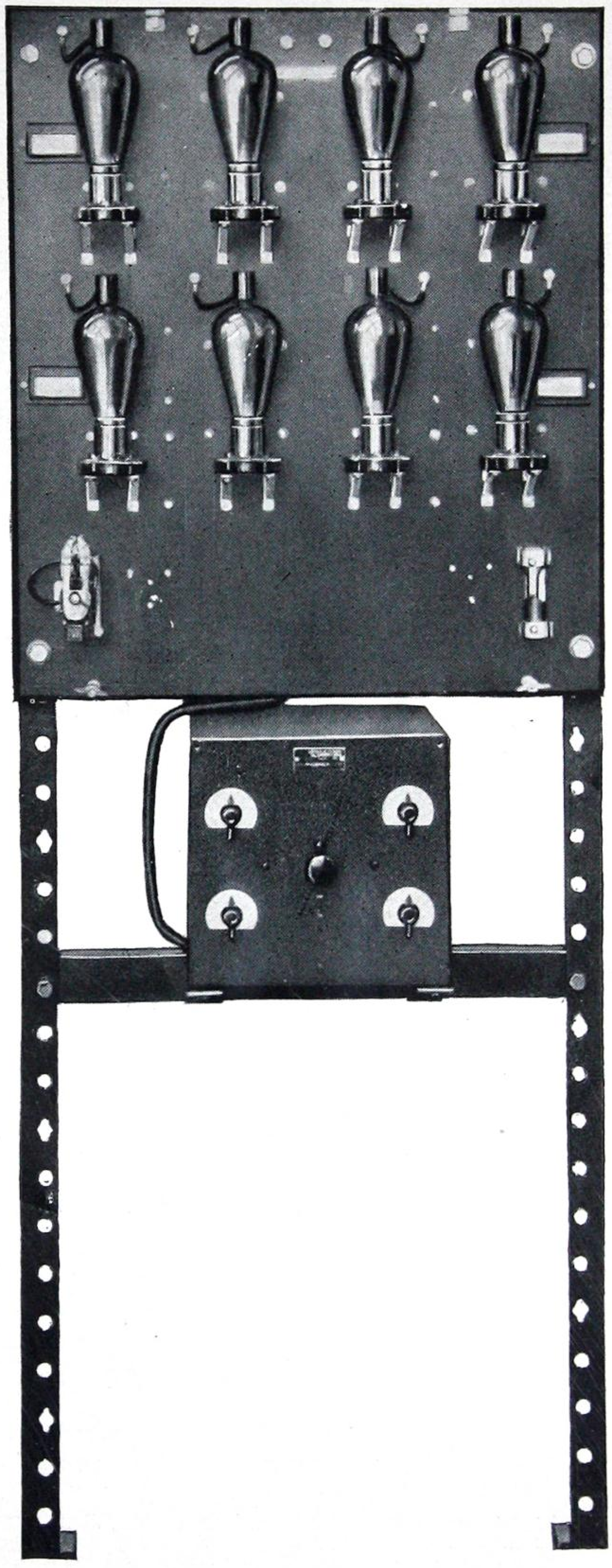

Fig. 8
Type CR7502-A1 Thyratron Tube Panel and Voltage Regulator Timer Panel (Grill Cover Removed) for Thyratron-reactor Control. The regulator panel can be located where it is most convenient

* One voltage regulator will control a maximum of three pairs of tubes.

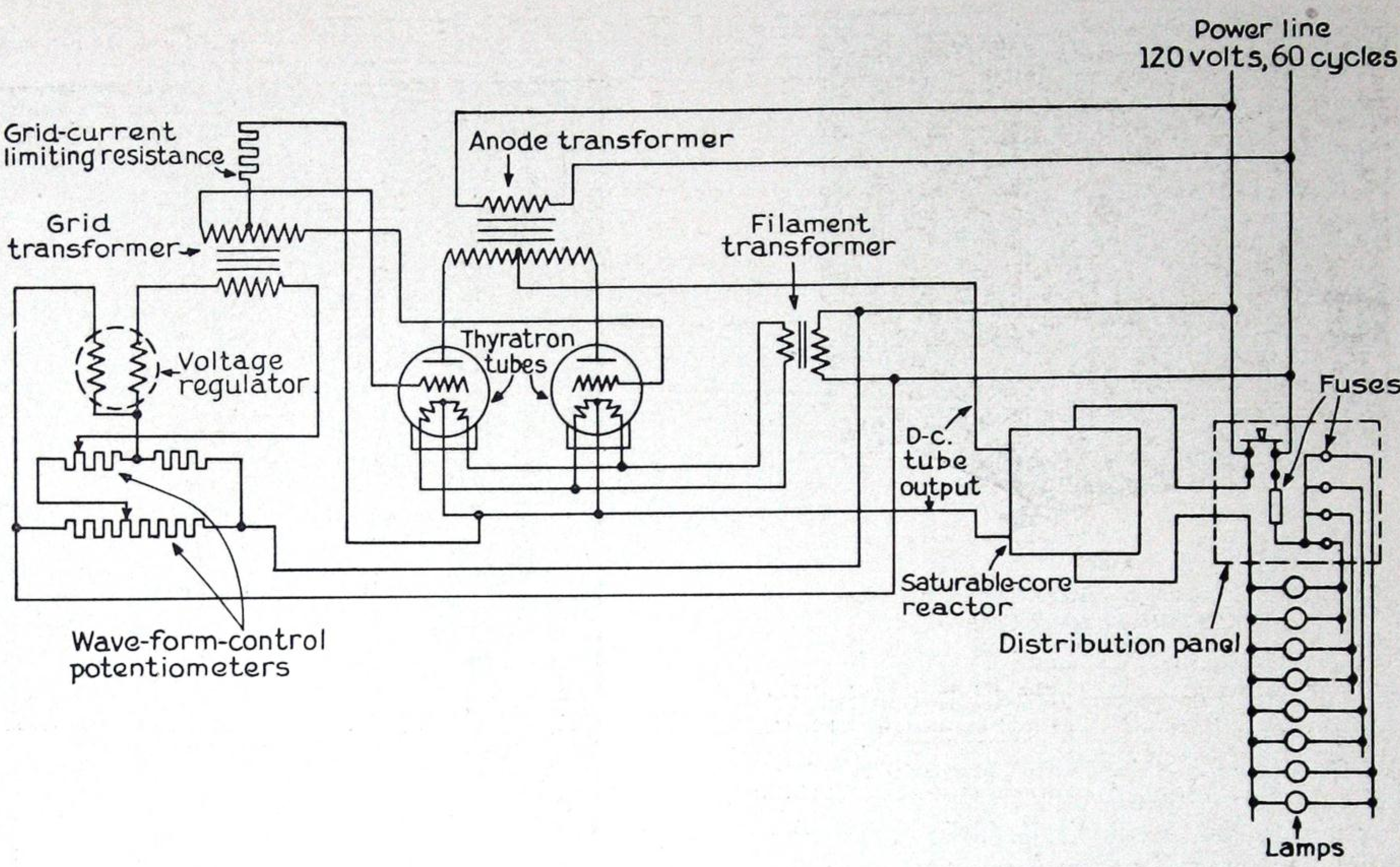

Fig. 9

Connection Diagram for Single Thyratron-reactor Circuit

ADVANTAGES

Some advantages of the Thyratron-reactor control equipment over ordinary types of dimming and control equipment are:

1. No moving parts carrying load current
2. No flickering of lights—a gradual transition from one setting to another can be effected
3. Very high efficiency over the required dimming cycle on incandescent lamps; consequently very little heat to be dissipated

The following tabulation gives a comparison of efficiencies between the Thyratron-reactor control and the resistance type of lighting dimmers based on an 8-kw. load:

PER CENT LAMP CURRENT	PER CENT EFFICIENCY	
	Thyratron-reactor	Resistance
100	98	100
90	97.5	83
80	96	68
70	95	54
60	92	42
50	88	32
40	80	21
30	63	14
20	30	8

4. Practically noiseless—the only rotating parts are a Telechron motor driving a small induction voltage regulator through a changeable-gear transmission
5. Very flexible as to:
   (a) Load per pair of tubes
   (b) Total time cycle for complete effects
   (c) Shape or gradient of dimming cycle
   (d) Relation of each dimming circuit to others on small phase-shifting device
6. Electrically, rather than mechanically, connected apparatus provides:
   (a) Remote control, when desirable
   (b) Long life, since there are few wearing parts
   (c) Easy repairs in case of failure
7. Space required for installation is smaller than for any other type of dimming equipment when comparable loads are considered
8. Reactor drop at full load is low enough to permit use of 115-volt lamps on 120-volt circuits, or 110-volt lamps on 115-volt circuits
9. Number and size of auxiliary control parts greatly reduced
10. Ease of adjustment for different effects

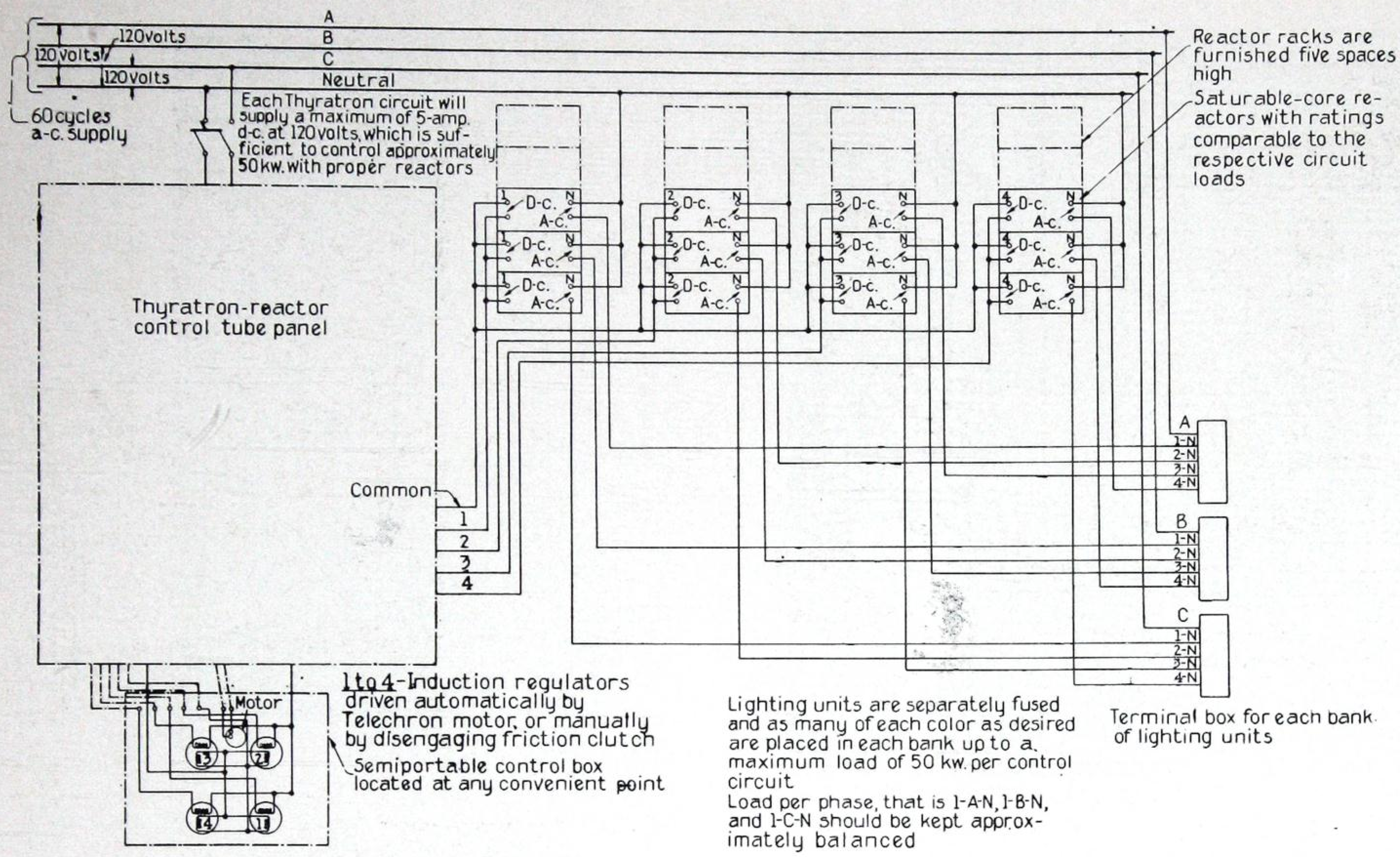

Fig. 10

Connection Diagram Showing Arrangement of Reactors for Three-phase Floodlighting Circuit. Key: A-c. =Load or a-c. side of reactor; D-c. =control or d-c. side of reactor; 1, 2, 3, and 4 =control circuits; A, B, and C =lines; N =neutral. Example: 1-A-N represents neutral-to-line-A voltage controlled by control circuit No. 1. Note: When ordinances require loads to be split in 15-amp. circuits, reactor sub-panels are required. See Fig. 11.

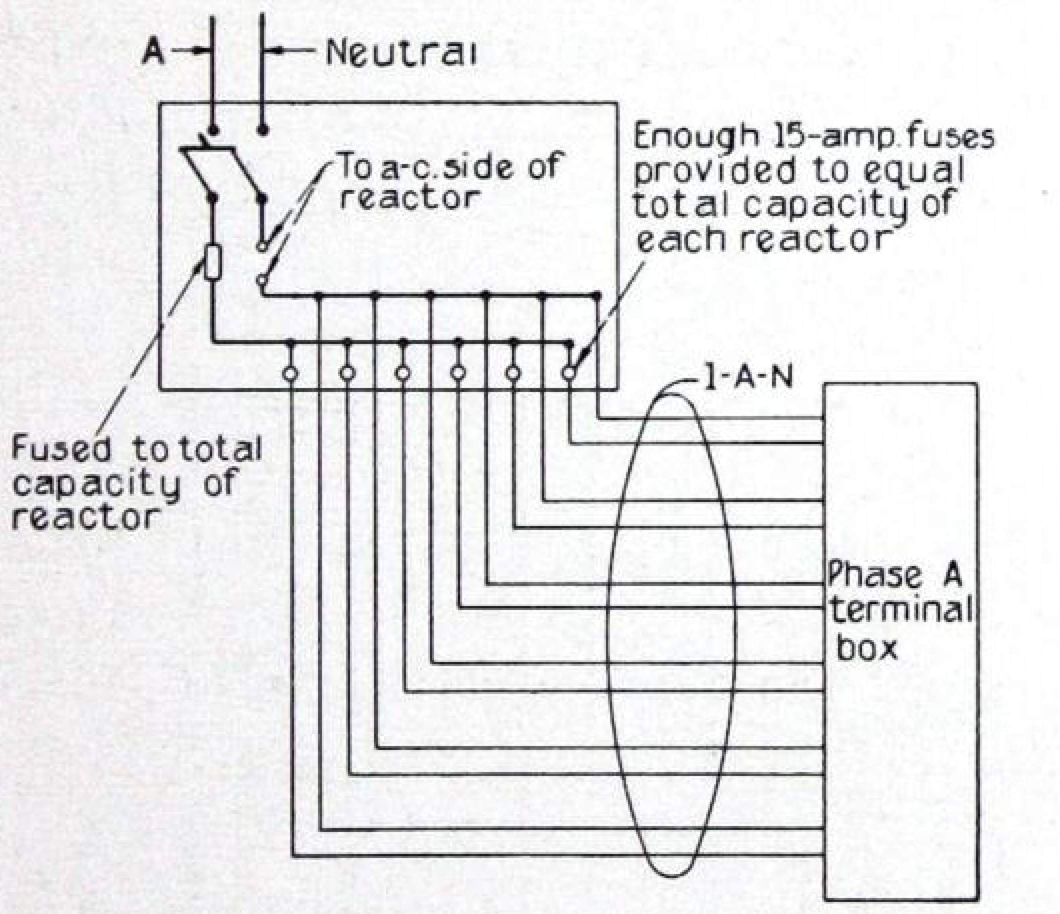

Fig. 11

Detail of Reactor Sub-panel. One panel is provided for each reactor and is mounted on front of reactor rack

The saturable reactors are usually mounted on a structural-steel framework consisting of sections approximately 76-in. high, 2-ft. wide, and 2-ft. deep, and accommodating five reactors, mounted one above another. Each rack is provided with a distribution panel also mounted on the framework. These distribution panels are equipped with 12-amp. fuses to split up the reactor circuit into 1000-watt branch circuits, thus making a compact arrangement which minimizes heavy circuit wiring and permits locating the framework at the center of distribution.

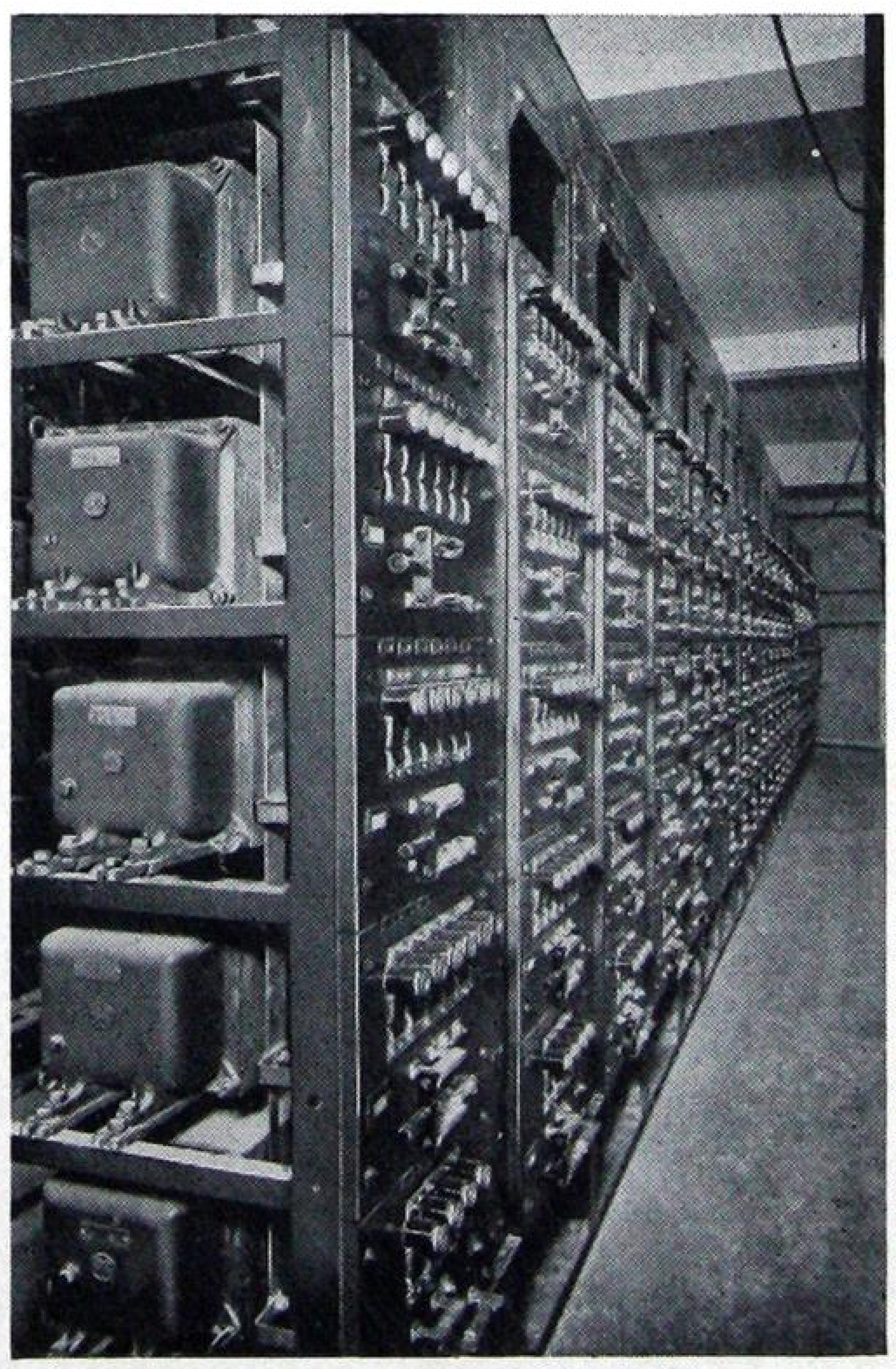

Fig. 12

Installation of Reactor Racks with Distribution Sub-panels at Chicago Civic Opera House. See Fig. 11

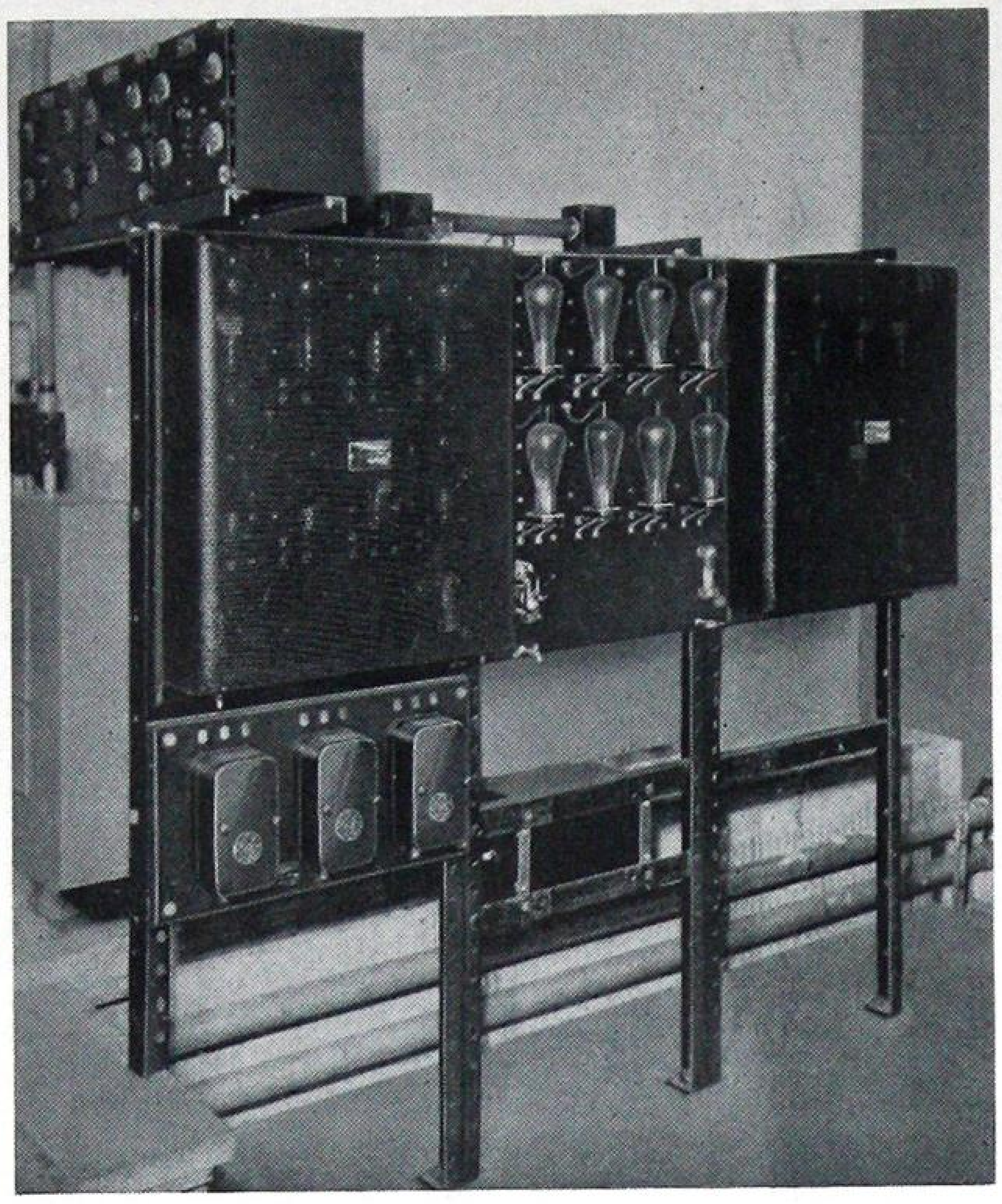

Fig. 13

An Installation of Thyratron-reactor Control Showing Three Tube Panels with Grill Cover Removed from Middle Panel. The voltage-regulator panels are mounted on a shelf to the left

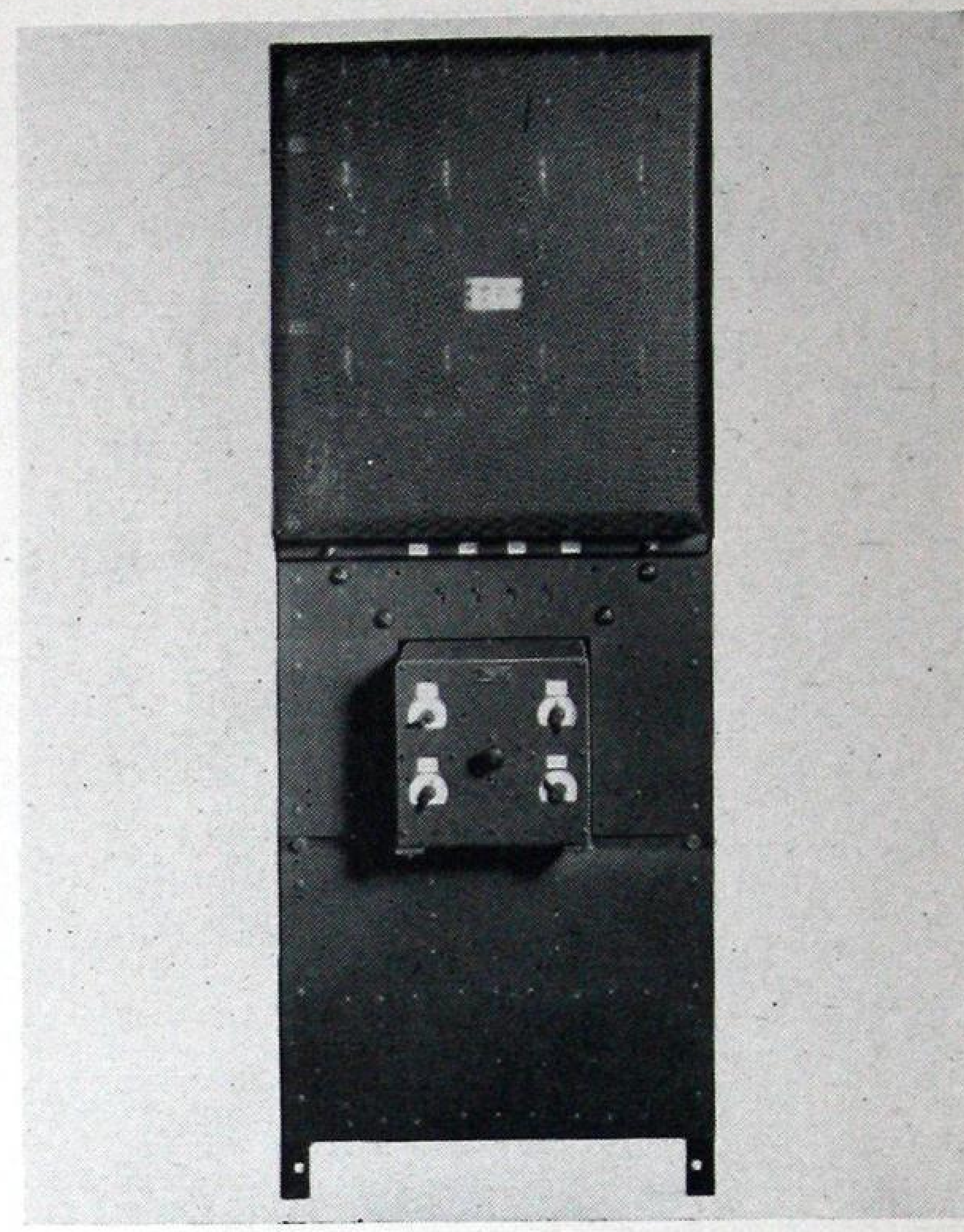

Fig. 14

Thyratron-reactor Control Panel as Modified by RCA Victor Company for the Synchronization of Music and Colored Light

INFORMATION FOR ORDERING

The following information is necessary in preparing the specifications and quotations for Thyratron-reactor control:

I. For all Thyratron-reactor installations:
   1. Exact power supply available, giving (a) voltage, (b) phase, (c) frequency, and (d) number of wires.
   2. Number of circuits to be controlled and watts per circuit.
   3. Number of watts per distribution circuit allowed by local authorities.

II. Additional data required for exterior mobile lighting.
   1. Previous recommendations or complete blueprints so that Illuminating Engineering Laboratory can make its own recommendations.
   2. Color cycle, color combination, and time cycle desired, and the results expected.

III. Additional data required for all interior mobile lighting.
   1. Detailed blueprints showing space available for installing control equipment.
   2. Give type of installation, such as building lobby, hotel ballroom, restaurant, night club, or recreation hall.
   3. Color cycle, color combination, and time cycle desired, and results expected.

IV. Additional data required for fountains and waterfalls.
   1. Number of projectors.
   2. Color and time cycle.

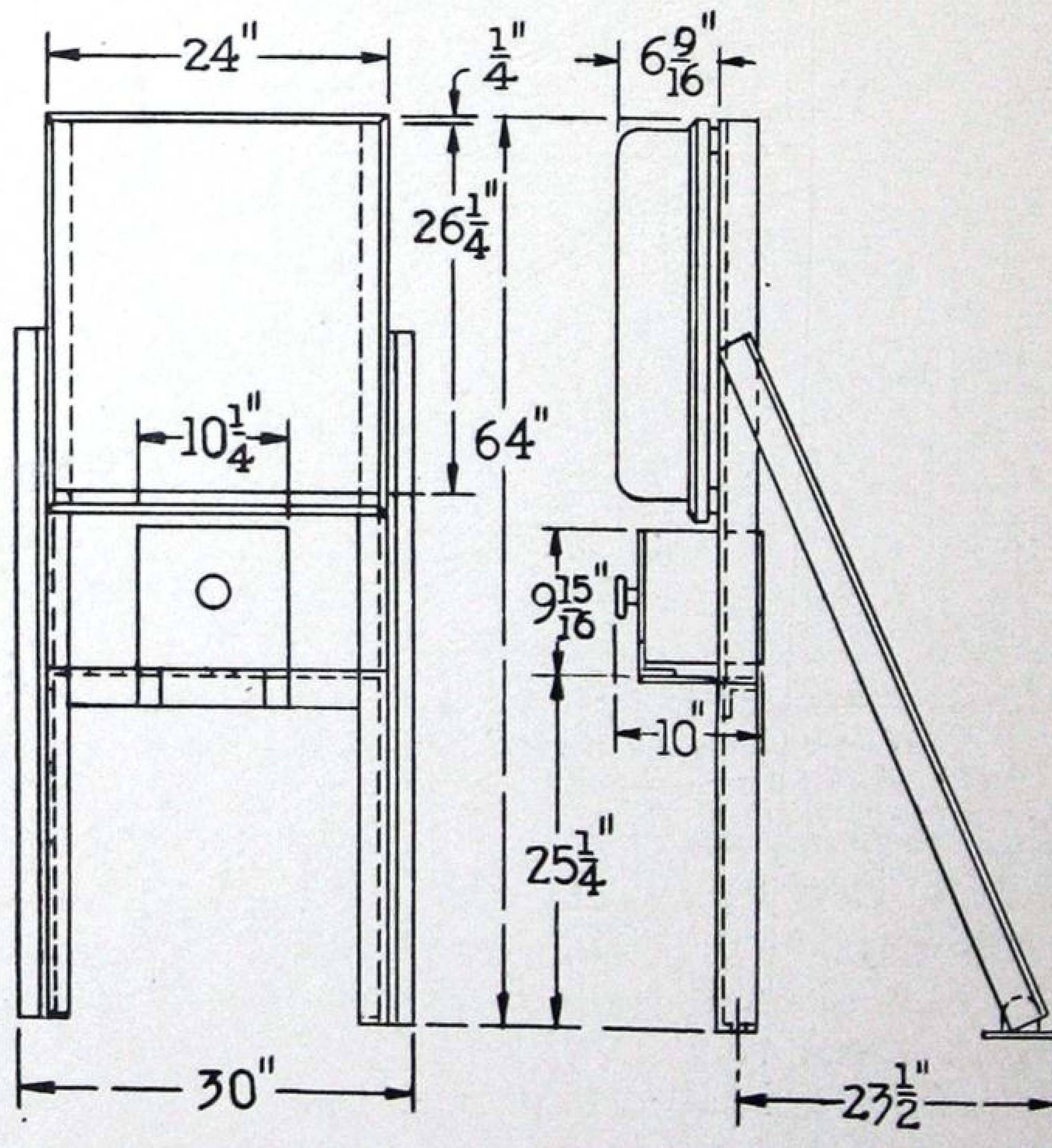

Fig. 15

Outline and Dimensions of Thyratron-reactor Control Tube Panel. Dimensions are approximate and not for construction

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SWITZERLAND: Trolliet Freres, Geneva

URUGUAY: International General Electric, S.A., Montevideo

VENEZUELA: International General Electric, S.A., Caracas and Maracaibo

A GENERAL ELECTRIC FOUNTAIN

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